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Dietary Intake and Health Outcomes

Final Report

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Abstract

The Harvard Service Food Frequency Questionnaire (HSFFQ) has been used in the Special Supplemental Nutrition Program for Women, Infants and Children (WIC) in North Dakota, Missouri, and Massachusetts. This project collaborated with those States to improve HSFFQ output to better facilitate nutrition education, food package decisions, and referrals; to design, implement, and evaluate the use of aggregate nutrition data for local and State practices and policy decisions; and to use prospective data to examine the relationships between diet and childhood obesity. The project developed a standardized version of the HSFFQ to make collecting and compiling aggregate data easier and to make data reports more useful. The project demonstrated that aggregating nutrition data at the State level is feasible. The calibration studies uncovered the need for further analyses to explain the performance of the tool in the diet assessment of low-income Hispanic and African-American children. Prospective analysis of the influence of diet on overweight in low-income preschool children, while inconclusive, demonstrated the ability to use aggregate nutrition data to explore important epidemiological hypotheses.

Food Assistance and Nutrition Research Program

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NOTE TO READERS

During this project, the Institute of Medicine (IOM) published a report on "Dietary Risk Assessment in the WIC Program" (2002). Some of the report's recommendations affect the usefulness of the project's findings. In particular, the IOM recommends against using individual-level dietary assessment data—as would be provided in the output from the Harvard Service Food Frequency Questionnaire (HSFFQ)—to determine eligibility status for the WIC program or for nutrition education purposes. Errors in individual-level reporting greatly reduce the validity of the data for assessing diet in individuals. Therefore, the project's improvements in the HSFFQ output to facilitate individual-level nutrition education, food package decisions, or referrals may no longer be relevant. USDA's Food and Nutrition Service is making recommendations to the WIC program about the use of dietary assessment methods.

Despite these limitations, however, the IOM concludes that the errors are less serious in group assessments. The aggregated data, therefore, could be used for identifying dietary patterns in a WIC population and patterns that need improvement, for monitoring group-level changes over time, and for assessing effects of nutrition education interventions. Group assessment data would be collected best by trained individuals on randomly selected subsamples of the WIC population. Any tool used for this purpose still must be evaluated in terms of the criteria presented in Chapter 4.9 (that is, "a tool would still need to be easy to administer, appropriate for the group and reasonably accurate."

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Focus group participants from the North Dakota WIC Program

This report represents the collaborative efforts of many individuals, including the advisory committee and staff, and the Harvard study group and staff whose names appear at the beginning of this document. Completion of this project was complex and required substantial dedication and effort by all those who participated throughout its completion.

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We extend our gratitude to the 4 WIC sites in North Dakota that piloted the Client Printout preceding the focus groups. Thanks to the WIC nutritionists and clients in North Dakota who took the time to participate in both rounds of those focus groups. Hank Dart and Morgan Ford worked closely with the study group and utilized the focus group input to develop the Client Printout. With the help of the focus groups they successfully designed a functional final product for the efficient and valuable nutrition education of WIC clients.

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For the Harvard Research Study Group

Boston, Massachusetts
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Executive Summary

Background

Diet assessment

Diet assessment facilitates early detection of asymptomatic children with dietary intake problems, creating an opportunity for early intervention before more marked effects such as weight loss or obesity become apparent. In a report on dietary assessment in the Special Supplemental Nutrition Program for Women, Infants & Children (WIC), the Institute of Medicine (IOM) concluded that although dietary assessment methods (i.e., 24-hour recalls, food frequency questionnaires) are not accurate for assessing diets of individuals, they have an important role in WIC for planning or targeting nutrition education for WIC clients and, given the less serious nature of the errors in group assessments, provide useful population level nutrition information that is helpful in program planning and policy evaluation (1).

Nutrition Education

Diet information provides a starting point for nutrition counseling. When diet assessment is omitted nutrition education tends to be general rather than tailored to individual needs (2). The use of a personalized evaluation of dietary quality has been shown to enhance awareness and motivation for dietary change. When advice is carefully focused, behavior changes have been accomplished (3). In our own work in Massachusetts we observed that the majority of WIC visits include some 10 to 15 minutes of nutrition education, reflecting the integral part this plays in the services that are provided (4).

Pediatric obesity

Obesity now affects 1 in 5 children in the US. Many of the consequences of adult obesity begin in childhood--for example hypertension, abnormal glucose tolerance and hyperlipidemia occur with increasing frequency among obese children and adolescents. Questions remain as to whether the onset of obesity in early childhood carries greater risk of adult morbidity and mortality. Yet the underlying importance of preventing childhood obesity due to its strong relation to

adult obesity and the associated chronic diseases, mandate a more rigorous understanding of the relationship between diet and the development of this common childhood condition (5). Further study of diet and obesity and the predictors of the onset of obesity in much larger populations are needed.

The prevalence of obesity has been rising rapidly in the United States, supporting the notion that this is not just a genetic condition, but rather a consequence of lifestyle, including diet. An interaction between our underlying genetic make up and an environment that discourages physical activity and encourages consumption of calories, is fueling the growth of obesity (6). Does diet composition contribute to the development of obesity above and beyond total caloric intake?

Project overview

The overall goal of the proposed project was to build on ongoing Harvard collaborations with WIC programs in North Dakota, Missouri, and Massachusetts to increase the usefulness of the Harvard Service Food Frequency Questionnaire (HSFFQ) and its associated dietary data output in improving nutrition education and guiding program planning. In addition, prospectively collected state WIC data were utilized to examine relations between diet and health outcomes in children with obesity at 4 years of age as a prototype. The project aims were to:

1. Evaluate and improve the HSFFQ output to better facilitate nutrition education, food package decisions, and referrals.

2. Design, implement, and evaluate the use of aggregate nutrition data for program planning and evaluation at the local and state levels, by aggregating diet assessment and administrative data from WIC programs in collaborating states.

3. Utilize prospective data collected through the WIC program to examine relations between diet from age 2 to age 4 and childhood obesity, as

measured by excess adiposity among 4-year-old children. Specifically, test the hypothesis that a high-fat diet leads to greater childhood obesity and that a diet high in fruits, vegetables, and fiber is associated with lower levels of obesity.

To achieve these objectives we completed the following tasks:

A. Conducted focus groups on-site in North Dakota. North Dakota was chosen as the most appropriate location for the focus groups given their history and statewide experience with the Harvard Service FFQ (HSFFQ) (complete implementation and regular use of the HSFFQ for nutrition assessment and education throughout the North Dakota WIC Program). The first round of focus groups were run to learn about how the HSFFQ was used by WIC providers to deliver nutrition education to WIC clients. The second series of focus groups was conducted following the pilot run of a newly developed "Client Printout" to learn about its effectiveness from both WIC clients and nutrition counselors.

B. Developed a standardized version of the HSFFQ under the Nutrition Education aim to ease the expansion of the use of the HSFFQ in service and research settings.

C. Implemented common procedures in North Dakota and Missouri for collecting statewide WIC data, compiling it and sending it to Harvard for analysis. Harvard returned an aggregate report for use in program planning and evaluation at local and state levels.

D. Collected dietary intake data on low-income African American and Hispanic children in an attempt to expand the calibration of the HSFFQ and broaden the usefulness of the HSFFQ in assessing diet and informing nutrition education in multi-ethnic populations.

E. Compiled longitudinal data from North Dakota and prospectively examined the influence of dietary composition and beverage consumption on changes in body mass index among low-income preschool children.

It should be noted that as part of the original proposal the study group recommended a review of the dietary assessment tools currently in use or being developed by different WIC programs. During the course of exploring this task, it was revealed that the Institute of Medicine (IOM) was conducting just such a review as part of their review of dietary risk assessment in the WIC program. Therefore, we did not pursue this proposed task and refer the reader to the IOM report, "Dietary Risk Assessment in the WIC Program" (1).

A national advisory board comprising representatives from the states, National Association of WIC Directors, the Center for Disease Control and Prevention and US Department of Agriculture provided guidance throughout the study.

Findings from focus groups

Use of HSFFQ in nutrition counseling in North Dakota

North Dakota WIC dietitians do both individual and group counseling. They use the HSFFQ printout for individual counseling in conjunction with several nutrition handouts. Some dietitians write or circle items on the handouts to personalize them for WIC clients. They often use the HSFFQ and its printout to clarify dietary intake.

Client printout

Four sites in North Dakota piloted the client printout for approximately one month prior to the focus group feedback from WIC providers and clients. At all sites the client printout was distributed to the women one month after the completion of the HSFFQ. The month-long time-period between the completion of the HSFFQ and receiving the printout did not concern the clients or the providers. Four of the clients said that the printout was not a good indication of what they usually ate because they did the HSFFQ when they were in early pregnancy and had

"morning sickness all day". The providers reported that they liked the client printout and would use it for all clients except those with developmental delays or language issues.

Overall, the reception of the client printout was positive by both providers and clients. Many wanted to know when something similar would be available for children.

Standardized HSFFQ

The development and use of the Harvard Service Food Frequency Questionnaire (HSFFQ) continues in service settings such as prenatal clinics, Head Start Programs, schools, and WIC programs for both service and research purposes. The standardized product, although presented differently, contains the majority of the core foods found on the HSFFQ used in each of the 3 states. The last page of the standardized questionnaire includes questions that examine fiber intake, type of fat eaten, fried food consumption, and multi-vitamin and supplement use. In addition, the last page will offer the user (practitioner, researcher, etc.) a choice of 1 of 3 different modules of questions that ask about physical activity, food security or food scarcity, food behavior (see Appendix E). The standardized HSFFQ is available in English and Spanish and in a paper or direct-enter computer format.

Explanation of aggregate data reports with reference to examples

Aggregate data reports are currently created and utilized by North Dakota and Missouri. Each state compiles the HSFFQ data for their state and sends it to Harvard for analysis. Harvard runs specific analyses on the data and returns an aggregate report back for use in state WIC program planning and policy decision -making.

The Advisory Board to the ERS/USDA Dietary Intake and Health Outcomes grant developed a standard format for the state reports. Each report includes population nutrition information for children, pregnant women, and post-partum women (lactating and not lactating) broken down into specific age groups. The

contents include overall nutrition statistics, a list of the top 10 foods that contribute to each nutrient, mean consumption per day for 7 food groups and 2 nutrients, a list of what foods contribute to each food group, a list of the contents for the raw nutrient file, and the raw nutrient file for 18 nutrients (see Table 1 in the main report for further detail). An example report is included in Appendix F. In concept each state receives the exact same information as decided on by the Advisory Board. In practice the states' agendas continue to evolve and in response to these changes modifications are made to the aggregate data reports.

North Dakota has used the data to examine differences in dietary intake in pregnant women and children 3 to 5 years old by annual family income and family size. Missouri used the data from the HSFFQ to evaluate the influence of a nutrition education and Farmer's Market Voucher pilot project on the consumption of fruits and vegetables in a small population of women and children in the WIC program. Both examples demonstrate the ability of a state to use the data from the aggregate data to answer questions deemed important by state health departments.

Calibration study results

In previous studies evaluating the Harvard Service Food Frequency Questionnaire (HSFFQ) the term *validation* has been used to describe studies using the same methods employed in the completion of the *calibration* studies described in this report. Calibration is another commonly used term to describe studies that quantitatively compare values from one method of diet assessment (i.e., food frequency questionnaire) to values from a "gold standard" method of diet assessment (i.e., 24-hour diet recall) (7). The term calibration is used throughout this report.

African American Children

For the 108 African American children aged 1 to 5, participating in Massachusetts WIC with complete data, feasible daily energy intake (500 – 3500 kcal per day), and who were not siblings, we compared the first of 2 Harvard

Service Food Frequency Questionnaires (HSFFQs) collected to the average of 3 24-hour diet recalls to calibrate the questionnaire. Pearson correlation coefficients, adjusted for total energy intake and within and between person variation, were calculated for the following 7 WIC nutrients: protein (r = 0.37), vitamin A (r = 0.45), vitamin C (r = 0.007), folate (r = 0.27), zinc (r = 0.15), calcium (r = 0.13), and iron (r = 0.23).

For the African American children used in this calibration research, the ratio of within to between subject variability is greater than that found in the North Dakota calibration for sixteen out of the nineteen dietary nutrients/substances. This implies that a greater number than the three 24-hour recalls that were collected would be necessary to accurately represent the diet of these children (8). Thus, the fact that these correlations were somewhat low, may not necessarily imply that the Harvard Service FFQ (HSFFQ) has a poorer validity among African American children, but may instead reflect the inadequacy of the three days of diet recalls as the gold standard representing the diet of these children. The increase in this ratio could be due to the generally increased availability of foods in the greater Boston area as compared to North Dakota.

Hispanic children

To calibrate the questionnaire for use in Hispanic children aged 1 to 5 years we compared the first of 2 Harvard Service Food Frequency Questionnaires (HSFFQs) collected to the average of 3 24-hour diet recalls. The final sample comprised 45 children after excluding individuals with reported energy intake below 500 kcals or above 3500 kcals, siblings, and those missing 1 or more diet recall(s). Pearson correlation coefficients, adjusted for total energy intake and within person variation, were calculated for the following 7 WIC nutrients: protein (r = 0.04), vitamin A (r = 0.07), vitamin C (r = 0.04), folate (r = -0.32), zinc (r = 0.07), calcium (r = 0.28), and iron (r = 0.16). Given the small final sample of Hispanic children who participated in and completed the calibration study (n=45), the correlations, as well as the within and between subject variability have very wide confidence intervals. Therefore, these results should not be used to draw

conclusions about the validity of the Harvard Service FFQ (HSFFQ) among low-income Hispanic children participating in WIC.

Analysis of the ratio of the within and between subject variability suggests that, as with the African American sample, a greater number of 24-hour diet recalls may have been necessary to accurately estimate "true intake" and to adjust for day-to-day fluctuations in an individual's intake (i.e., within subject variability) for the Hispanic children who participated in the present calibration study. This may be related to the variety of foods available in an urban area like Greater Boston. An increased variety could affect the day-to-day differences in food intake for each individual because more choices are available.

Findings from prospective analysis

Prospective analyses looking at dietary composition, beverage consumption, and changes in body mass index among low-income children 2 to 5 years of age using linked, longitudinal data (Harvard Service FFQ, WIC Certification data, and vital statistics data) from the state of North Dakota were completed. The aggregate nutrition data from WIC was linked to vital statistics, birth certificate data, in order to obtain additional variables needed to conduct a thorough analysis (e.g., birth weight and maternal education). The first analysis tested several hypotheses, considering both nutrients (total fat, animal fat, vegetable fat, and fiber) and pre-defined North Dakota (ND) food groups[1] (fruits, vegetables, breads/grains, and “fat foods”) used for nutrition counseling in the North Dakota Special Supplemental Nutrition Program for Women, Infants, and Children. (Please refer to the original printout for client nutrition education included in Appendix B for food group definitions). After univariate and multivariate regression analyses were performed for all nutrients and foods, only vegetable intake was significantly related to larger decreases in BMI. Further research is

[1] Nutritionists at the North Dakota WIC program modified the HSFFQ food groups (used to derive daily food serving and nutrient intake information) for state-specific uses. These predefined food groups (hereafter referred to as “ND food groups”) are used in this study. The ND food groups are similar to the categorization scheme used in the USDA Food Guide Pyramid[9]. The ND food groups are not related to the WIC federal food package, nor are they federally defined food groups. The groups were created for dietary analysis and nutrition education purposes and are used for nutrition counseling at North Dakota WIC clinics.

needed to reproduce these findings when controlling for additional risk factors such as familial obesity and physical activity.

The second analysis explored the hypotheses that fruit juice, fruit drinks, milk, soda, and diet soda are positively related to changes in BMI. Changes in BMI were not significantly related to intakes of fruit juice, fruit drinks, milk, soda, or diet soda in either univariate or multivariate analysis. Results did not change when further adjusted for sociodemographic variables. Similar findings were seen when intakes of milk and juices were dichotomized into excessive ($\geq$ 12 oz) consumption categories. The influence of beverages on body weight may be more important for older children who consume a more varied diet.

Review of diet assessment tools currently in use or being developed by different WIC programs

Please refer to the 2002 Institute of Medicine Report: "Dietary Risk Assessment in the WIC Program" (1). It can be read on-line and/or ordered at: http://www.nap.edu/books/0309082846/html.

Conclusions

The use of the Harvard Service FFQ (HSFFQ) has been successfully implemented and is on-going in all 3 collaborating states. With the input of health communication specialists, WIC practitioners, and clients, the HSFFQ Client Printout has been tested and refined and is currently used to provide valuable individually tailored nutrition education. The newly developed standardized version of the HSFFQ will facilitate the expansion of its use to additional settings, ease the collection and compilation of aggregate data, and aid the production of useful data reports.

The results of the calibration component make it clear that further analyses are necessary to explain the performance of the tool in the assessment of the diet in low-income African American and Hispanic children. The poor results may have been a result of the study methods, and not a reflection on the performance of

the HSFFQ in these populations. The previously reported validity of the HSFFQ can not be disregarded. The validity reported by Suitor et al., Blum et al., and Wei et al. demonstrate that nutrition data for Native American and Caucasian children ages 1 to 5 and multi-ethnic pregnant and postpartum women can be reliably collected and utilized to provide tailored nutrition education. Furthermore, as demonstrated in the state data aggregation component of this project, it is feasible to combine nutrition data at a state level to be utilized by local, state, and national agencies to answer important questions and inform current program practices and policy decisions.

While inconclusive, prospective analysis of the influence of diet on overweight in low-income preschool children demonstrated the ability to utilize aggregate nutrition data to explore important epidemiological hypotheses.

The experiences of the past 3 years have been invaluable in uncovering both the significant administrative issues that must be addressed and those that will facilitate the process of data aggregation and increase the likelihood of successfully sustaining the implemented system. Before any benefits of collecting aggregate nutrition data and potential linkages can be reaped on a local or state level it is essential that the regulations regarding the use of WIC data be clarified to facilitate uniform policy interpretation across states. The following steps will facilitate the data aggregation process and increase the likelihood of a sustained nutrition data aggregation system:

1. Designation of a state WIC Program or Department of Public Health staff member with understanding of nutrition data structure and other state data sources as the official state nutrition data coordinator. The state nutrition data coordinator must be given clear responsibility and have an appropriate amount of their time allocated to nutrition data collection and aggregation to facilitate the use of the nutrition data.

2. Orientation around the diet assessment method and the collection of aggregate nutrition data for state WIC program administrators and providers to become acquainted with the utility of the system.
3. An introductory phase followed with additional orientation and training around the diet assessment tool and aggregation of nutrition data.
4. An approximately six month practice phase of aggregate nutrition data collection to resolve issues before annual data compilation officially begins.
5. Successful annual data compilation by Information Systems and state appointed nutrition data coordinator sent for analysis and report generation.

Once the above steps are taken and the listed supports are put in place will the inherent benefits of these data be reaped by local and state programs and policies.

Future goals should include further calibration of the HSFFQ in Latinos and African Americans using our established criteria and methods. Further work is needed to better understand the assessment of diet in this subgroup of the population.

To support the continued use of these valuable data, it is essential that a funding source and functional body be identified. With expansion to additional states the data collected through WIC may offer a unique window on evolving patterns of diet and child growth. From our experience the management of the compilation and use of these data would be best accomplished by an entity residing within a state system. This will help regulate the many administrative and practical steps that must be completed to successfully link the numerous data sets that various agencies may contribute.